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ABSTRACT

This manual gives descriptions of and control methods for the imported fire ant, sweet potato pests, the white fringed beetle, the Japanese beetle, and phony peach disease. Toxicity, formulation, and application information is given for 2,4-D, methyl bromide, Chlordane, Mirex, and Mocap. Finally, environmental considerations and precautions are given for fumigants, organochlorines, organophosphates, and herbicides. (BB)

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This training manual is intended to provide you with the information you will need to meet the standards of the Environmental Protection Agency for pesticide certification, and prepare you to take an examination given by the Georgia Department of Agriculture based on this manual. It is not intended that this training will provide you with all the information you need for effective Regulatory Pest Control. Additional information in the form of publications and short courses can be obtained from the Cooperative Extension Service and other government plant pest regulatory agencies.

Appreciation is expressed to everyone who reviewed this manuscript and provided helpful suggestions.

Appreciation is also expressed to:

Vickie Chamblee

who provided the illustrations

for this manual.

INTRODUCTION:

The Entomology Act of 1937 authorizes the Commissioner of Agriculture to promulgate rules and regulations when necessary to combat outbreaks of plant and insect pests in the State of Georgia. These regulations are contained in Chapters 40-4-1 through 40-4-18 of the Rules of the Georgia Department of Agriculture for Entomology and Plant Industry. These regulations should be reviewed prior to the use of this manual.

As a Department employee, you will rarely be called upon to apply pesticides for any purpose. However, your responsibility is to inspect various commodities, plant material and lands for the presence of regulated pests. If regulated pests are present it is often necessary to instruct the owners of the infected commodities, plant materials or lands in the proper control of pest organisms.

As new products are developed or older product registrations are amended, recommendations for the control of regulated pests will change. Therefore, it is imperative that you keep informed of the current recommendations and approved products for your particular program.

The information contained herein, especially the pesticide information, is of a general nature. You must remember that the label is the final authority on any question concerning the approved use and application of a particular product.

Employees involved in enforcing the Nursery Regulations will also be responsible for the information contained in the commercial pesticide applicator's Ornamental and Turf Pest Control Training Manual.

Employees involved in enforcing the Structural Pest Control regulations will be responsible for the information relating to the Industrial, Institutional, Structural and Health Related Pest Control category.

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The information included in this training manual has been adopted from Georgia Department of Agriculture and Georgia Cooperative Extension Service information pamphlets, the "Agricultural Chemicals" Reference Series, and various product labels.

THE IMPORTED FIRE ANT

The imported fire ant, a native to South America, was introduced into this country in 1920. It now ranges across the entire Southeastern U. S., westward to Texas.

Imported fire ants physically resemble native fire ants, however their behavior is quite different.

Imported fire ants build large earthen mounds averaging one foot high and two feet across. They prefer cleared land open to the sun. Valuable farm land, improved pastures and hay fields are especially hard hit with mounds numbering as many as 40 per acre.

Imported fire ants can be transported to new areas on plants with soil attached and in loads of soil, sand, gravel, hay, sod, wood and lumber.

These ants feed on a variety of material, exibiting a slight preference for protein foods. They are a pest of livestock and cultivated crops. However, the more serious damage results from mechanical damage to machinery from mounds, and through stings to humans.

When disturbed fire ants are very aggressive and will attack in force. Fire ants can sting repeatedly and inject a venom that causes the skin to burn and itch. A white sore or

pustule will form and this sore can leave a permanent scar. Some persons may exhibit an allergic reaction to fire ant venom and should be given medical treatment for such reactions.

Fire ants are social insects and are established by new queens who have emerged from an old colony, mated and given birth to a brood of workers. After the first generation of workers has matured, the workers take over the responsibility for maintaining the colony. This frees the queen to produce eggs. It is not uncommon for queens to live several years. When a mound is disturbed the workers will be observed. They are from one-eighth to one-fourth inch long, wingless and vary from reddish to blackish in color.

CONTROL METHODS:

There are two chemicals currently being used to supress the imported fire ant populations. These are mirex and chlordane, both are organochlorines. When used as directed these chemicals do not present dangers of unacceptable environmental effects.

Chlordane is used in control programs to treat mounds in nurseries, at shipping points and in other restricted areas where the treatment would not endanger people, livestock or wildlife.

Mirex bait is used for spot treatments as well as broadcast treatments ranging from a few acres to over a million acres.

Mirex bait is designed to take advantage of the feeding habits of fire ants. The foraging worker ants bring food into the mound where it is fed to the queen and ant larvae. Therefore, even if the bait does not kill all the workers immediately, treated fire ant colonies will eventually die out because no new generations can be produced.

SWEETPOTATO PESTS

The native habitat of the sweetpotato weevil is unknown. It was first reported in this country in Louisiana in 1875. Since that time this pest has spread throughout the Southeastern U. S.

The sweetpotato weevil is destructive to sweetpotatoes in all stages of growth and to stored potatoes as well. Heavily infested potatoes are unfit for human or livestock consumption because of the extremely bitter taste that develops.

Principal damage of the weevil is done by the larva or grub which tunnels throughout the potatoes. This larva is a legless white grub about 3/8 inch long with a brown head. The pupal or resting stage is also white with partially developed snout, legs and wings folded around the body. The adult weevil is about 1/4 inch long, dark blue on the head, snout and back, and brick red in the middle and on the legs.

The weevil lays its eggs in small holes which it punctures in the potato vines, usually near the crown of the plant or in the potatoes if they can be reached. In favorable weather, the eggs hatch in about a week. The grubs feed in the vines or potatoes from two to three weeks, after which they pupate and approximately one week later emerge as adults. One female lays from 100 to 300 eggs. Under favorable conditions six to eight generations may be produced.

Principal host of this insect is the sweetpotato; however, some morning glories, close relatives of the potato, are quite important hosts and must be given due consideration in areas where they exist. Escaped ornamental morning glories have

perpetuated the sweetpotato weevil in quite a few instances in Georgia. Most of the areas in Georgia where heavy populations of these morning glories exist are in towns. Constant vigilance must be maintained to prevent potato plantings in such areas or the dissemination of infested material.

Morning glories in infested areas have been observed primarily, along railroad tracks. The control of these morning glory infestations is essential to eradicating the weevil from the infested areas. Several herbicides are labeled for, and provide satisfactory control of morning glories.

In addition to the sweetpotato weevil, several diseases and nematodes are a threat to economic production of sweet potatoes.

To produce disease free sweetpotatoes it may be necessary to apply fumigant-type nematicides. Most of these contain methyl bromide. Contact nematicides are also used. These may be used earlier in the year, incorporated directly into the seed bed.

In conjunction with chemical control techniques, the Department also requires cultural control practices. These include the establishment of non-planting zones, one mile in diameter, around all known infested sites. All host material in these infested areas must be destroyed for at least one year.

WHITE FRINGED BEETLE

White-fringe beetles are native to South America and were first identified in this country in 1936. They have caused severe crop damage throughout the Southeastern U. S.

These beetles appear to be capable of surviving in a variety of climates and are therefore not restricted to their present range.

The adult beetles do not fly, therefore they spread to new areas primarily in commerce. Adults may attach themselves to seed cotton, hay, agricultural implements or even to man. Larvae may be spread by the movement of soil, sod, nursery stock, and root crops, such as potatoes. Hay harvested from infested fields in late summer and fall may contain viable eggs.

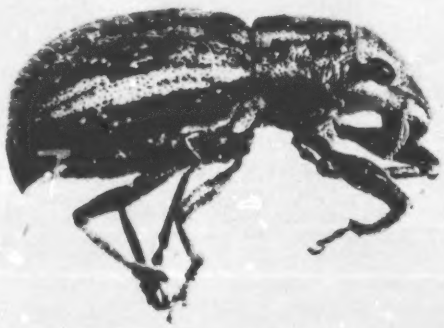
This beetle is a serious pest of field, garden and ornamental crops. The principle damage is caused by larvae feeding on the roots and underground stems of plants.

In general, plants with main roots (tap roots) are damaged more severely by the larval stage of the insect than those with fibrous roots. The larvae may sever the main root while they are feeding. On root crops, such as potatoes, carrots, and turnips, they burrow directly into the roots, or tubers, and destroy the market value of the crop. The larvae also feed on the roots of young woody plants such as peach, pecan, and willow, as well as on parts of dead plants in the soil. The adult beetle prefers to feed on plants having broad leaves. The larvae and adults do not always feed on the same plant species. Plant hosts will therefore not be a limiting factor in the spread of these insects.

A number of factors may influence the intensity of an infestation. The beetles are more abundant- and damage is greater - in well-drained, sandy loam than in heavy clay soils.

The white-fringed beetle passes through the following stages: Adult, egg, larva, and pupa. It usually produces only 1 generation a year, and spends all but about 3 months in the soil.

Adults begin emerging from the soil early in May and continue to do so until early fall, the exact time of emergence depending on the locality. They are dark gray, about 7/16 inch long, and have a white fringe, or band, along the outer edges of the body. They feed on margins of leaves for several days and then begin laying eggs. All adults are females and are capable of laying fertile eggs.



The eggs are laid in masses in the soil (usually near the roots or a plant), or at the point of contact between soil and objects such as sticks, gravel, plant stems, and other things lying on or protruding from the soil.

How many eggs an adult lays and how fast she lays them depend upon the kind of plant on which she feeds. Legumes and broad-leaved plants, such as cocklebur, rag weed, peanuts, soybeans, and strawberries, induce heavy egg laying; while cowpeas, blackberry, lespedeza, Mexican clover, pecan, and tobacco have the opposite effect.

The right combination of temperature and moisture is required for the eggs to hatch. Eggs laid during the summer usually hatch in about 17 days. But those laid during the fall and winter require longer periods - sometimes as much as 100 days.

Some eggs may remain viable throughout the winter and hatch the following spring.

The larvae are yellowish-white grubs that are up to 1/2 inch long. They enter the soil and feed almost constantly. As they grow, they molt, or shed their skins, several times. It usually takes about 11 months for the larvae to develop, but under certain conditions some larvae require 2 years or more. Normally, these insects pass the winter as larvae in the soil, but they may overwinter as eggs. In the spring and summer, the larvae construct cells 2 to 6 inches below the soil surface where they transform into pupae. In about 13 days, the adults emerge.

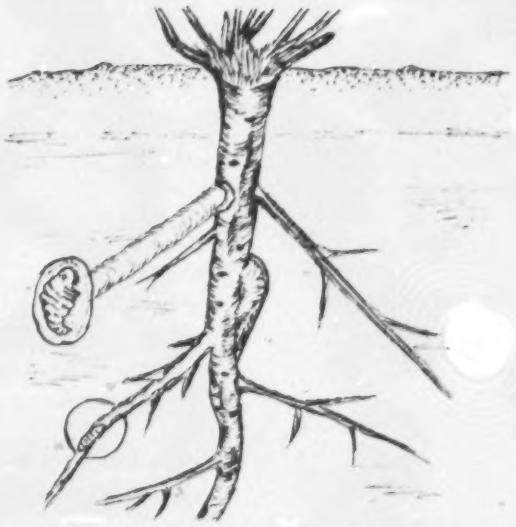
White fringed beetles can be controlled or eradicated through the use of approved insecticides. Chlordane, is one of the products approved for use in Georgia. Chlordane is representative of the class of compounds known as organochlorines,which is used to control white-fringe beetle. These products are also approved for Japanese beetle control.

To control the beetles in cultivated land, broadcast on the soil surface and immediately after application thoroughly mix the insecticide into the upper 3 inches of the soil. The insecticide can be mixed into the soil by the use of a disk or other suitable farm implement.

In applying the insecticide to the soil surface, every effort should be made to obtain an even coverage. If the field is covered with heavy vegetative growth, it is recommended that it be plowed prior to the application of the insecticide as this will be helpful in obtaining an even distribution.

An alternate treatment which will give crop protection is to apply one of the recommended insecticides, alone or mixed with fertilizer, in the drill row at the time of planting. This is not as good as the broadcast method in reducing the beetle population, especially the first year; its use over a period of years will result in good control.

An off flavor can develop in certain crops following the use of chlordane. Check the label and product guides prior to the use of these products for precautionary statements.



Noncultivated land, such as lawns, industrial and railroad properties, roadsides, and wasteland, that is not used for grazing animals can be treated with a surface application of chlordane. Surface applications require heavier dosages than soil applications. Granulated products should be applied uniformly over the area to be treated, while the plant foliage is dry. For best results, apply the insecticide only during the winter and early spring. When applying the insecticide, precaution should be taken to prevent the contamination of streams, ponds, watering troughs, and to protect animals, fish, and wildlife.

JAPANESE BEETLE

The Japanese beetle was first introduced into this country in 1916. It was first identified as a pest of nursery stock in New Jersey. Since its introduction, it has spread westward to the Mississippi River and along all of the Gulf States.

This pest can be spread on grass sod, soil, plants and earth moving equipment. Consequently quarantine programs are difficult to maintain.

Adult Japanese beetles feed on fruit and foliage, striping leaves down to the veins. Larvae feed on roots of grasses and other plants. The Japanese beetle is a pest of turf, fruit, vegetables, grains, and ornamental shrubbery.

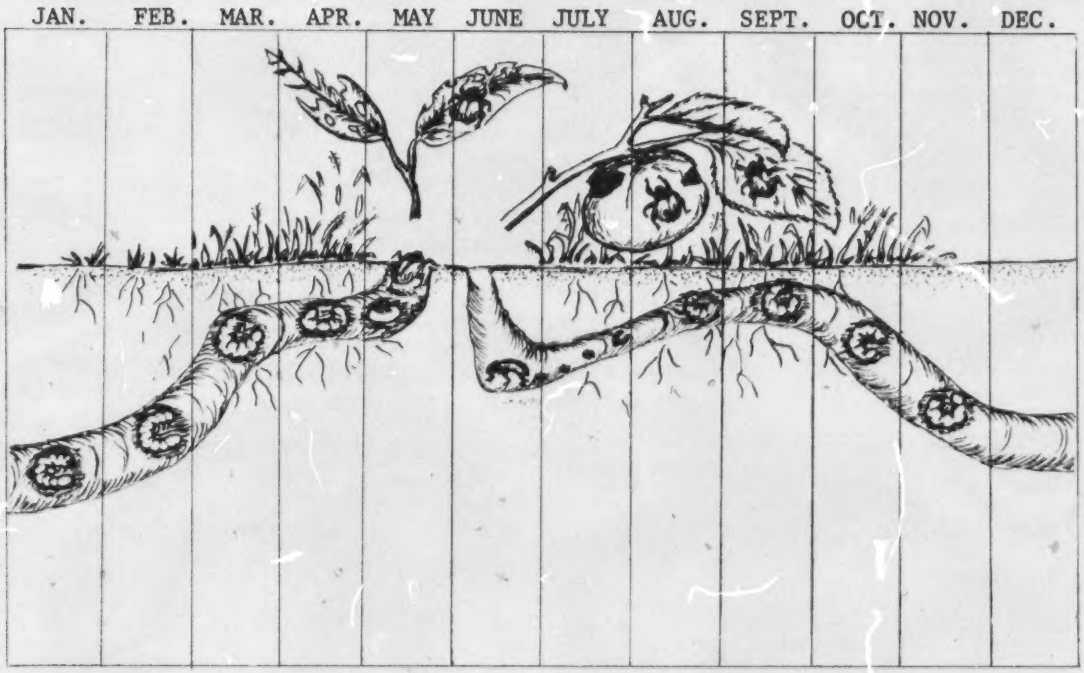
Adults are approximately 3/8 inch long, broadly oval with brownish wings. The head and thorax is greenish-bronze. They have six small patches of white hairs along the sides and back of the body, under the edges of the wings.

The larvae are small C shaped white grubs, 1 inch long.

Japanese beetles normally produce one generation a year. Adults emerge from the soil in late June and live 30-40 days, feeding on foliage and fruit and depositing eggs in the soil.

Several organochlorine compounds, including chlordane are effective against the Japanese beetle.

Insect parasites and milky disease are important sources of biological control on the larvae and these methods should be employed when practical.

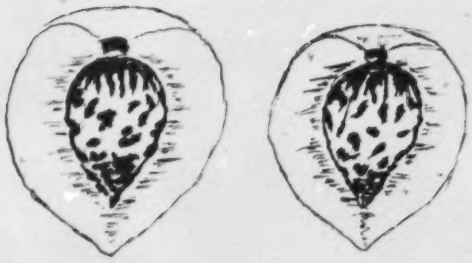


PHONY PEACH

Samuel Rumph first noticed "phony peach" about 1885, but it was not until 1915 that growers realized it was an infectious disease. About 1928 research scientists discovered that phony peach was caused by what was believed to be a virus. It has recently been shown, however, that a rickettsia is the causal agent rather than a virus. In 1949 scientists were successful in transmitting this microorganism from tree to tree with insects.

Normal Phony

Normal Phony



Phony trees bloom earlier in the spring than healthy ones. Infected trees leaf out earlier than normal ones and hold their foliage longer in the fall. Once a phony tree leafs out, it takes on a compact appearance due to the shortened internodes of the terminal shoots. The flattened, dark green leaves on phony trees form a dense, dwarfed foliage with a rounded shape. No upright shoots extend beyond the dense growth. Fruit is reduced in size and number. It may be more highly colored than fruit from a normal tree and usually ripens a few days earlier.

The phony disease normally spreads very slowly except in concentrated centers of infection. When healthy trees are set near diseased

ones, symptoms begin to appear about the third growing season. When diseased roots are grafted onto a healthy tree, symptons occur in about 18 months or may not be seen for two years. Thus far, leaf hoppers are the only insects known to transmit the causal agent from diseased to healthy trees.

CONTROL

Remove all infected trees as soon as they are detected. Pull out the entire tree, including the roots. When trees are simply cut down, infected suckers grow back and can be more dangerous than the tree that was removed. The best time to detect infected trees is in July and August when the compactness of growth and dark green foliage are most striking. Tag an infected tree if it blooms and leafs out 7 to 10 days before others of the same variety and remove it if the foliage shows virus symptons after it is completely leafed out.

Remove all wild plums from within 300 yards of your orchard since this disease can live on wild or domestic plums. Wild plums are effectively controlled by spraying hedgerows with 2,4-D.

Don't grow domestic plums near peaches. Plums are a good source of infection.

Keep weeds and grass, especially johnsongrass, clipped closely. Excessive ground cover in an orchard provides a food supply for insects.

INSECT SCOUTING

The following procedures will be helpful in scouting for sweet potato weevils, white fringe beetles and Japanese beetles.

For Larvae

Look for larvae, or grubs, in soil around the roots of plants, particularly plants that are wilting or dying.

Inspect young plants, particularly seedlings, during the spring months in farm fields, vegetable gardens, and flower beds, for abnormal symptoms, such as wilting, reddening, and yellowing. Examine the soil where skips occur in the rows of plants.

Dig out abnormal plants by the roots and break the soil apart. Look for larvae on the roots, and also in soil. It is often necessary to examine the roots and soil of several wilting or yellowing plants before finding larvae.

For Adults

Examine the outer edges of the leaves for sawtooth cuts; adults do not make holes in the leaves.

Inspect cultivated crops, such as soybeans, velvetbeans, peanuts, cotton, and clover to see if the outer edges of the leaves show insect damage.

Look for adults on broad-leaf weeds growing in the fields, along the terraces, turn rows, or fence lines. (Where both small grains and weeds are found in the field the adults will feed on the weeds.)

Look around the base of the plant, under leaves, or in grass if you don't find adults on the leaves.

The above techniques are useful in scouting for many varieties of soil insects and foliage feeders.

FUMIGANTS

Methyl Bromide

TOXICITY

LD_{50} 0.8mg/kg. Exposure to 2000 ppm for one hour may be lethal.

FORMULATIONS

26, 69, 98 and 100% liquids, 98% compressed gas. Often sold mixed with chloropicrin.

USES

Used as a soil fumigant, on commodities or in greenhouses. See the label of the product being used for specific commodity approval.

IMPORTANT PEST CONTROLLED

1. Weeds, nutgrass, bermuda grass, johnson grass and annual weeds as well as the seeds of most plant species.
2. Fungi - Damping off species, Sclerotinia, and many others.
3. Nematodes - Most plant parasitic species.
4. Insects - Most species of insects and mites.
5. Rodents - Controls all species of rodents.

APPLICATION:

Soil:

Work soil into a fine loose condition. Dig a trench around an area slightly smaller than the tarp cover (usually polyethylene). Place the cover over the area with the edge in the trench. Seal by covering the edge with soil. The compound is applied with a special can opener type of applicator which carries the gas through a plastic tubing under the cover to the evaporating pans. Expose for 24 - 48 hours under the cover. Aerate 2 - 10 days before planting. The cover can some times

be held about 6 inches above the soil surface with the edges buried for effective fumigation. Also it can be applied by soil injection to a depth of 12 inches with the injections 4 - 6 inches apart. This method should be covered also. Soil temperature 4 inches below the surface should be above 60° F before treating.

ADDITIONAL INFORMATION:

Colorless, odorless, non-flammable gas. Since it is non-flammable it is frequently mixed with other fumigants to reduce the fire hazard. Rate may have to be doubled to control damping off fungi and Schlerotium rot in tobacco, flowers, vegetables, turf, and forest beds. Used to a limited extent as a rodenticide. The higher dosages in the soil are required to control fungi diseases. Very good penetrating ability. Chloropicrin is often added as a warning agent.

PRECAUTIONS:

A soil filled with water gives little chance for gas penetration. Don't apply near desirable plants since it is extremely phytotoxic. Don't use in greenhouses if temperatures are above 90° F. Beneficial soil organisms may be killed. Don't fumigate grain if moisture is high. Causes the accumulation of bromides in the soil. Don't over dose or injury may occur on fruits, corn, tubers, bulbs, and dormant woody plants. Remove any sulfur containing articles before fumigation. If a gas mask is used do not depend on chloropicrin as a warning agent.

Extreme caution must be exercised to prevent humans and pets from entering an area undergoing fumigation. Warning signs should be erected and the area being treated should be secured to prevent the entry of children.

HERBICIDES:

2,4-D

2,4-D is a selective, translocated phenoxy herbicide used mainly in post-emergence applications. It is marketed under many different trade names. All products should be used in conjunction with label recommendations.

TOXICITY

LD_{50} - 375 mg./kg

FORMULATIONS

Sodium And Ammonium Salts, Amine Salts, High Volatile Esters, Low Volatile Esters.

Other Formulations

Various forms formulated as 10 - 20% granules, EC 3 - 6 lbs. actual/gallon, 6 lbs. oil soluble concentrate/gallon. WP 95%. Sold mixed with oil solutions, fertilizers, and others.

USES

Labeled for a wide variety of uses - refer to the individual label.

IMPORTANT WEEDS CONTROLLED

Most broadleaf weeds and herbaceous plants.

RATES

Applied at 1/4 - 4 lbs. actual/acre in 2-100 gallons of water. Refer to the product label.

APPLICATION

General usage, post-emergence -- Wet foliage to the point of runoff on perennials and hard-to-kill weeds. Most effective on young, rapidly growing weeds. The

temperature during application should be between 50 and 90° F.

PRECAUTIONS

Avoid drift. Very susceptible plants include cotton, tomatoes, grapes, fruit trees, and ornamentals. Do not apply near desired plants. Low volatile esters may become volatile at 90° F and above. Excessive 2,4-D salts in the soil may temporarily inhibit seed germination and plant growth. Application equipment must be thoroughly cleaned with special materials before applying other pesticides to desired crops. Do not use on dichondra, St. Augustine grass, lippagrass, bentgrass, or clover turf, or turf that is not yet established. When used as an aquatic herbicide, decaying weeds may off-flavor water for a short period.

ADDITIONAL INFORMATION

Heavy rains will not leach all of the chemical out of the soil. Attacks weeds as they germinate when applied pre-emergence. Delay cultivation as long as possible following application. Amine salts are less hazardous than ester formulations to adjoining crops; so used more extensively on small grains. The vapor from low volatile esters will cause little injury to susceptible crops growing nearby at ordinary temperatures. Esters are used on the same crops as the amines at the same or slightly reduced rates. Low pressure sprays are less likely to drift. Applications should always be in droplet form, rather than a mist or fog. At the usual dosages,

soil micro-organisms are not affected. No risk of accumulation in the soil from one year to another. All phenoxy herbicides break down rapidly due to the actions of sunlight and micro-organisms. 80-90% of these compounds, applied to the soil, will break down within one year of application. Illegal residues from the use of these products are rarely a problem. The plants absorb the salt formulations more readily than the acid or ester. Esters tend to resist washing from the plant. Plants are the more susceptible when they are growing rapidly. Susceptible plants usually become malformed before they die. May be mixed with liquid fertilizers.

INSECTICIDES:

CHLORDANE

Chlordane is an organochlorine insecticide showing contact, stomach poison, and fumigant action with some residual effects.

TOXICITY

LD_{50} - 500 mg./kg. Moderately irritating to the skin. Absorbed through the skin.

FORMULATIONS

8 lbs. active/gallon, WP 40, 5-10% dusts or granules, .2-20% oil solutions, 2-3% aerosols, and 1/2-2% fertilizer mixtures. Also combined with a number of other compounds.

PHYTOTOXICITY

Considered non-phytotoxic when used at the recommended rate. Off flavor has resulted in potatoes, corn, and plums. High concentrations are injurious to some vegetables. Residues in the soil may depress germination.

USES

Consult the product label.

IMPORTANT PESTS CONTROLLED

Ants, cutworms, armyworms, leaf miners, weevils, ticks, loopers, lice, chiggers, chinch bugs, cockroaches, corn earworms, boll weevils, crickets, earwigs, wireworms, flies, fleas, grasshoppers, Japanese beetles, wasps, lygus bugs, mosquitoes, thrips, sowbugs, spiders, spittle bugs, termites, and many others.

RATES

Applies at 1-10 lbs. actual/acre.

APPLICATION

1. Soil -- Before treating, the soil temperature should be at least 55-60°F. Higher dosages are required on peat

and muck soils. The entire area should be treated before planting and disc into the top few inches of soil. It may also be applied as a side-dress band, in the transplant water, or as a seed treatment.

2. Foliage -- Apply evenly and thoroughly repeating as necessary.

3. Households -- Apply liberally to cracks and other areas where insects may hide.

PRECAUTIONS

Don't feed treated forage or crop residues to livestock. Persists in the soil. Harmful to fish.

ADDITIONAL INFORMATION

Gives residual termite control in the soil. Compatible with other pesticides. Non systemic.

MIREX

Mirex is an organochlorine insecticide which kills by contact and as a stomach poison.

TOXICITY

LD_{50} - 600 mg/kg. or higher

FORMULATIONS

0.15 - 0.30% baits containing soy bean oil and corn cob grits.

PHYTOTOXICITY

Not generally used on plants but no problems are forseen when applied according to directions.

USES

Agricultural premises, livestock pastures, and cropland.

IMPORTANT PESTS CONTROLLED

Imported fire ants, Argentine ant, Tropical fire ant, Southern Fire ant, Big-Headed ants, Western Harvester ant, Pyramid ant, Pharoah ant and Little Black ant.

RATES

Bait materials normally contain about 2/3 gram actual/pound. Apply 1/2 ounce of mixed bait per ant mound. As a broadcast treatment, apply 2½ lbs. bait per acre. The label on a given formulation is the final reference.

APPLICATION

Apply either individually to the base of each ant mound or use a broadcast treatment on a highly infested area. Livestock need not be removed from pastures during application. Application should be made when ants are the most active (April through October). Treat new

mounds as soon as they appear. If ants are still active after four weeks, retreat the mound. Individual mound treatment is the least effective of all control techniques. Broadcast treatments have proven to be the most effective control measures carried out. The effectiveness, degree of control and length of control seems to be directly proportional to the size of the area being treated and the number of applications. One broadcast treatment usually eliminates more than 90% of the mounds in a treated area. Three applications at six month intervals virtually eliminates all mounds exposed to treatment.

PRECAUTIONS

Make no more than three applications during a 12 month period. Do not use other insecticides on the same area as they may interfere with the effectiveness of the compound. Do not apply more than once during any two month period.

ADDITIONAL INFORMATION

Not harmful to fish or wildlife when used as recommended. Expresses a delayed toxic effect to ants. This allows the worker ants to carry the bait into the colony and distribute it among the other ants. Ants will usually die within 3-4 weeks.

Directions for use in Federal-State cooperative program for Imported fire ant suppression:

The rate and maximum number of applications will vary according to the formulation used.

Always refer to the label of the product being used for the specific application rates, instructions and precautions in government programs.

Aerial application is prohibited over heavily forested areas, which are defined as forest stands having 80% or more crown closure with trees of any size. All application, aerial or otherwise, is prohibited on or near aquatic habitats, which are defined as any aquatic system such as estuaries, rivers, streams, swamps, lakes, ponds or other bodies of water shown on U. S. Geological Topographic Survey Maps at a scale of 1:24,000, including farm ponds used primarily for food production or human consumption, but excluding intermittent streams and other farm ponds. Farm ponds to be excluded from the definition of aquatic habitats are defined as man-made impoundments of water occuring on farms for utilization for purposes such as irrigation, stock-watering and recreation. Intermittent streams are defined as those streams that have continuous flow during periods of heavy rainfall but with little or no flow during the remainder of the year. Do not apply to intermittent streams when flowing. Do not apply to water drainage areas where runoff or flooding will contaminate aquatic areas. Not for aerial application in coastal counties. Do not treat estuaries and other aquatic habitats or heavily forested areas. Toxic to shrimp and crabs.

MOCAP

Mocap is an organophosphate nematicide-insecticide which kills by contact.

TOXICITY

LD_{50} - 62/mg/kg. Readily absorbed through the skin.

FORMULATIONS

10% granules.

PHYTOTOXICITY

Non-phytotoxic when used as directed.

USES

Peanuts, soybeans, sweet potatoes, tobacco, turf and ornamentals.

IMPORTANT PESTS CONTROLLED

Plant parasitic nematodes, wireworms, corn rootworms, symphylans, and others.

RATES

Applied at 1-6 lbs. actual/acre.

APPLICATION

For broadcast treatment,

Use 60 to 80 pounds of the 10% granule applied evenly over the top of the soil with a lime spreader or similar type of applicator. Mix into the top 4 to 8 inches of soil right after application, using a double gang disc harrow or other equipment which will mix the granules should then be mixed well to a depth of 8 inches or more.

For row treatment,

Use 30 to 40 pounds of a 10% granule per acre on a 12- to 15-inch band. Mix the granules well into the top 6 to 8 inches of soil immediately after application. It is difficult to incorporate granules deeply enough in the row to obtain satisfactory control. With a narrow band it is also difficult to prevent recontamination of the treated areas.

PRECAUTIONS

Incorporate into the soil as soon as possible. Toxic to wild life.

ADDITIONAL INFORMATION

No fumigating activity. Kills upon contact only, although it does have some residual activity for about 8 weeks. Most effective on soil-borne insects and nematodes.

ENVIRONMENTAL CONSIDERATIONS AND PRECAUTIONS

The different classes of pesticides exibit very different chemical properties. These differences are very significant when you are selecting the proper product for a specific application. The insecticidal properties of one compound may make it very desirable from a control standpoint. However some other property may, from an environmental standpoint, make the choice unacceptable.

When choosing a product for a particular situation, all of the factors involved should be carefully considered from a risk/benefit standpoint.

Most restricted products that you will encounter will be either organochlorine, organophosphates, fumigants, or herbicides.

ORGANOCHLORINES

Organochlorines contain the elements chlorine, hydrogen and carbon. Dieldrin, chlordane, endrin, mirex, toxaphene, and D.D.T. are representatives of this group.

Organochlorines were first recognized for their pesticidal properties in the 1940's. These products have been invaluable as public health and agricultural pesticides. Unfortunately one of their properties, which makes them so valuable as a pesticide, can have negative effects on the environment if application is not properly controlled. This property is commonly called "persistence". This means that when applied these chemicals do not easily break down into less toxic substances. These products are therefore available to be picked up by non-target organisms.

Accumulation of these chemicals can occur in fatty tissue of organisms and lead to build-ups to toxic levels in animals further along the food chain.

Some insects have become resistant to organochlorines. This has led in some areas to a reduction of the use of these products.

Organochlorines act on the central nervous system in most organisms. They are effective contact and stomach poisons. These compounds are readily absorbed through the skin by humans. Aquatic organisms are extremely sensitive to most organochlorines insecticides. Oxygen uptake at the gills is impeded and death can result from suffocation. Therefore, in agricultural applications extreme care should be taken to avoid the contamination of water supplies with organochlorines.

ORGANOPHOSPHATES

The organophosphates are derived from phosphoric acid. Representatives of this group are parathion, malathion, and diazinon. All of these compounds have a similar mode of action. They are cholinesterase inhibitors or nerve poisons. They are effective as contact and stomach poisons.

The organophosphate insecticides began, in the middle 1960's, to replace the organochlorines pesticides. There are three basic reasons for the transition to the use of organophosphate insecticides.

(1) They are effective against insects resistant to the organochlorine compounds.

(2) They are biodegradable and do not contaminate the environment for a long time.

(3) They have less long lasting effects on non-target organisms. Organophosphates, although often acutely toxic to mammals have not presented a serious problem to aquatic life.

The primary danger from organophosphate insecticides is to the applicator himself.

These compounds are readily absorbed through the skin, the vapors are poisonous and should not be inhaled. Orally some of these compounds are acutely toxic.

The organophosphates exibit a wide range of toxicity, ranging from parathion which has an oral LD_{50} of approximately 5 mg./kg. to malathion which has an oral LD_{50} of approximately 1400 mg./kg. Because of the wide range of toxicities of products belonging to this group, each product should be evaluated on its own merit.

HERBICIDES

Chemical weed killers have been in use since the early 1940's. The development of these products has been greatly responsible for the dramatic increases in agricultural production over the last thirty years.

There are many types of herbicides available today. They can be broadly classified as selective and non-selective herbicides. Both selective and non-selective products can be applied to foliage or to the soil.

Examples of selective herbicides are 2,4-D and 2,4,5-T. Both of these are effective on broad leaf weeds and are used in cereal production. (Cotton is highly susceptible to 2,4-D). These materials are generally referred to as "phenoxy" or "hormonal" herbicides. These products are translocated throughout the plant.

Contact herbicides are a separate group of pesticides. Some of

these products are also selective or broad leaf weeds. They have a contact, burning action to plant tissue. Paraquat, another contact herbicide is effective on broad leaf weeds and grasses. It is selective because of placement only.

Most of the foliage-applied herbicides are effective on actively growing plants and have no long term action.

The soil applied herbicides act mainly on weeds as they germinate, and can be active for several months.

Herbicides generally have a low mammalian toxicity and do not present a hazard to the applicator. One exception to this is Paraquat, which is extremely toxic if inhaled or ingested and for which there is no known antidote.

The greatest danger from using herbicides is the potential economic damage from drift to adjacent cash crops.

Most herbicides are broken down either chemically or biologically in the soil. Foliage applied herbicides are broken down rapidly, and even persistent soil-applied herbicides disappear within a few months under most conditions. Soils of high organic or clay content can delay break down.

Research data gathered in recent years indicates that herbicide residues do not build up to unacceptable levels as a result of repeated annual applications.

FUMIGANTS

Fumigants are gases that kill body cells and tissues. They generally enter an organism through the respiratory tract and in some cases they can penetrate an insects body wall.

Fumigants are available in solid, liquid or gaseous form. They are active in gaseous form. The gases (molecules) penetrate cracks and voids in materials infested by insects.

The utilization of fumigants is limited by the following factors:

1. Flamability - Some fumigants must be mixed with non-flamable materials to render them safe for use.
2. Toxic hazards to applicators - fumigants potentially present a greater danger to applicators than any other pesticides.
3. High reactivity - They present a problem of poisonous residues and residual odors in food.
4. Tendency to corrode metals.
5. Lack of chemical stability.
6. Cost

All fumigants that are effective pesticides are toxic to man. Therefore it is necessary to add warning agents (dyes, or odors) to compounds that are naturally colorless or odorless.

No fumigant should ever be used unless it has these warning additives and the applicator is thoroughly familiar with fumigant application.

When taking part in a fumigation activity do not begin actual fumigation until you are positive that the area is secure and adequate measures have been taken to protect non-participants.